Description for the general public

Geophysical phenomena such as, e.g., seismic events, eruption of volcanoes, floods, hurricanes, weather or climate changes, movements of continents, mountain formation, changes of the magnetic field, are a result of complex physical (and chemical or even biological) processes. Note, that the their direct observation in most cases is unavailable. We must then limit monitoring to one or a few parameters being characteristic of the phenomenon. We often have only a scalar sequence of data (time series) but containing, hidden in it, important information about the examined process. Therefore, the properties of the time series reflect the complexity of the phenomenon and its features such as, e.g., a dependence on previous data (memory) which is quite universal in time series. Additionally, the typical irregularity of geophysical data induces us for making an assumption about the stochastic basis of observed time series.

The purpose of the project is to develop a method of modeling of nonlinear stochastic phenomena which are represented by time series with long memory. An innovative, nonlinear mathematical model describing the time series will be introduced. Then, novel procedures of reconstruction of the model from time series will be proposed and tested. Current models and methods of their reconstruction concerned only Markovian time series (without the memory).

Knowledge about the form of mathematical model is used for physical interpretation of the analyzed phenomenon. Moreover, it is a possible to determine the short-time transition probability which enables forecasting. In the case of geophysical phenomena the forecasting of extreme events is a main purpose in the safeguard of the society against destructive effects. In medical science, the modeling and time series analysis is helping specialists with the evaluation of the condition of the patient and enables to automate the diagnosis. It is also worthwhile recalling that nonlinear stochastic models are commonly used for description and forecasting of economic processes (e.g. stock exchange), so the extension of the tool for processes with the memory will be very useful in this field as well.